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Problems in Regard to Yellow Fever

AND THE

PREVENTION OF YELLOW FEVER EPIDEMICS

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PROBLEMS IN REGARD TO YELLOW FEVER AND THE PREVENTION OF YELLOW FEVER EPIDEMICS.

BY JEROME COCHRAN, M. D.,

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In the practical application of sanitary science, the question of questions in all our Southern communities is that which concerns the management of yellow fever and the prevention of yellow fever epidemics. The natural habitat of this disease is in the West India Islands, which are in constant communication with our gulf and Atlantic ports; and these again are in constant communication with all the cities and towns of our Southern states. The railroads, with locomotives running from twenty to forty miles an hour, have virtually abolished distances, and brought the whole interior of the country down to the shores of the sea.

Up to the present time yellow fever has never gained a permanent footing in any part of the United States—has never become naturalized amongst us; but we are now confronted with the danger that it may by possibility find an abiding domicile in the more southerly portions of Florida,—that is to say, in that part of the state of Florida below the frost line. Last winter it hibernated as far north as Tampa and Plant City, but last winter was exceedingly mild in Florida, and furnishes the first instance of hibernation that has occurred in the epidemic history of the state. In Jacksonville the winters are always cold enough to eradicate yellow fever. If we have, this coming winter, an average amount of frost and cold in Florida, I am of the opinion that there is not likely to be any hibernation of the disease in any of the places where it has prevailed this summer, unless it may be in the small towns on the Manatee river; and even in these small towns the chances are even that it will die out for want of material. In a large majority of epidemics that have visited Key West, where frost was never known to show itself, the fever has disappeared in the month of August; and it has never been known to hiberninate there.

Yellow fever is certainly infectious, and the specific poison that causes it—a poison as specific as atropia or hydrocyanic acid—can be transported from place to place in the ordinary vehicles of travel and traffic, in the bodies and baggage of men and women. This specific poison is undoubtedly connected in some way with the presence of some living organism, some bacterium, some microbe, some living disease-germ of some sort, and probably belongs to the class of chemical substances known as ptomaines. As yet neither the poisonous ptomaine, nor the

living organism which generates it, has been demonstrated; and so there are many unsolved problems connected with the etiology of the disease. A few of these I will briefly indicate:

(1) Does the pathogenic organism multiply its generations within the human body, or outside of it? or does it find conditions favorable to its growth and multiplication, both in the body of the patient and in the patient's environment? Its multiplication within the body of the patient has been denied, but I think not with sufficient reason. If the organism is not itself active within the body of the sick person, I known of no clue to the explanation of some of the facts connected with the propagation of epidemics. In the meantime its growth in the environment seems hardly to admit of question. Upon no other hypothesis can we explain the infection of localities.

(2) How does the specific cause of the disease find its way into the body of the patient? Is it absorbed through the skin? Hardly, I should think. Does it find its way through the pulmonary vesicles in the act of respiration? I know of no facts which favor this presumption. On the contrary, both the pulmonary vesicles and the expired air are singularly free from the presence of germs of any sort. Only one other avenue is left open for its introduction—the alimentary mucous membrane. In support of this doctrine, also, the paucity of facts is remarkable. In all the literature on the subject, so far as it is known to me, nothing is recorded to connect its introduction with the alimentary ingesta,—with any sort of food or drink. Can it be that the germs first find lodgement, in the act of respiration, in the mucous membrane of the mouth and pharynx, to be subsequently swallowed along with what we eat and drink? It must get into the system in some of these ways, and it seems to me that the probabilities are most favorable to the one last mentioned. But in regard to this, let it be remembered that for the present all is pure speculation—mere guess-work, and nothing more.

(3) If the germ is generated within the body, how does it find its way out so as to become an agent for the infection of communities and localities? Is it thrown off with the exhalations of the skin? with the sweat? Or is it thrown off with the expired air in the act of breathing? Or is it eliminated through the kidneys? Or does it make its exit through the great sewer of the intestines in company with the alvine excretions? We have absolutely no facts to enable us to answer these questions, but it would seem to be the more probable supposition that it escapes from the body with the dejections from the alimentary canal; and, if this is the case, Parke was right years ago when he called yellow fever a fecal disease.

(4) In the production of the clinical phenomena of yellow fever, the poison permeates the entire system of the patient. It causes marked nervous disturbance. It leads to fatty degeneration of the liver and other organs and tissues. It attacks the blood corpuscles so as to cause them to part with their coloring materials. It develops acute desquamative nephritis, with albuminuria and urinary suppression, and the whole

train of symptoms characteristic of what we ordinarily call uræmic poisoning. All these pathological phenomena may be ascribed, with great plausibility, to the action of the hypothetical ptomaine, which would readily find its way into the circulating blood, and so to all the tissues and organs of the body.

(5) Of the germ itself, as already stated, we know nothing in any positive and direct fashion. It has never been demonstrated. No man has ever seen it with his eyes, or touched it with his fingers. The *cryptococcus zantho genicus* of Friere, and the *peronospora lutea* of Carmona, are not real existences; and the germs of Finley and Gibier have not been shown to have anything to do in the production of yellow fever. It may be accepted as tolerably certain that in yellow fever no distinctive organisms are to be found in the blood or in the tissues. This seems to me to have been settled once for all by Sternberg's Havana researches in 1879. At any rate, all those at present engaged in this research have, by common consent, turned their attention to the flora of the alimentary canal. Theoretically, a microbe in the alimentary canal, generating a poisonous ptomaine, to be subsequently absorbed into the circulation, would account for all the phenomena of the disease.

Fortunately it is not necessary that all these problems of ultimate pathology should be solved in order that we may frame some rational scheme for the prevention of the spread of yellow fever. A few of the leading facts, derived from observation of the habits of the disease, and attending its dissemination in time and space, I proceed to mention very briefly:

(1) Yellow fever, as already stated, is infectious, and is propagated by the introduction into the human system of a specific poison, or of a specific organism which generates a specific poison, and which is transportable from place to place. In an immense majority of recorded epidemics the outbreak of the disease is in traceable connection with the introduction into the stricken community of some person from a place already infected, who has the fever at the time of his coming or within a few days thereafter. In a much smaller number of instances it is traceable to the introduction of baggage, clothing, or bedding, brought from some infected place, and which has been used about some one who had the fever. Other agents and vehicles of infection are so infrequently the causes of epidemics as not to require any special mention here.

(2) While the disease spreads from the patient, it is not, perhaps, at all, and certainly not to any considerable extent, contagious from person to person, like small-pox. In its transmission it is probably somewhat analogous to typhoid fever and cholera. It seems to take root in the locality—in the soil, as it were—and to be contracted from the environment of the patient rather than from the patient himself; and the locality remains infected after the patient has been removed—remains infected for weeks, and even months.

(3) But yellow fever does not always spread on the introduction of an exotic case. On the contrary, it is the rule, in the large majority of

instances, that one or two cases occurring in a community may fail to establish an epidemic. A thousand sparks may fall on the roof of a house, but perhaps only one of them kindles into flame and causes a conflagration. Doctors and nurses are frequently exposed for a long time before they take the fever; and very often they pass through an epidemic, and even through several epidemics, without contracting the fever. The great factor in the dissemination of the fever is human intercourse. It is known that scarlet fever and diphtheria can be carried from place to place by cats and dogs, and I know of no reason why the poison of yellow fever cannot be carried in the same way? Yellow fever is not disseminated ordinarily to any large extent by atmospheric currents. Ordinarily, it will not cross a street unless somebody carries it across. Ordinarily, it will not surmount a wall twenty feet high. It is usually not very dangerous to walk the streets of an infected city in the daytime. The danger is greater at night.

(4) The golden rule of prophylaxis in yellow fever is, non-intercourse—non-intercourse with infected places, non-intercourse with infected persons, and non-intercourse with infected things. If you keep away from the fire, you won't get burned, and it is not necessary to keep very far away either. The instances are very numerous in which prisons, jails, and cloistered convents, in the very midst of epidemics, have escaped infection. The instances are also numerous in which, in the midst of epidemics, private residences have in like manner, by the observance of strict isolation, escaped infection. These facts are of the utmost importance, and should be generally known and generally acted upon when yellow fever is on its travels.

(5) It seems reasonable to believe that in infected places all persons who are at all exposed must receive into their bodies some portion, larger or smaller, of the poisonous ptomaine which generates the disease, or some number, more or less, of the specific germs which generate the ptomaine. But all who are so exposed do not take the fever. In other words, the question of dose seems to be, in this case, as in other cases, a consideration not to be overlooked. Some of those exposed suffer no ill consequences whatever. Others suffer more or less malaise for longer or shorter times, but escape any decided attack of the fever. Others have the fever in mild form, and readily recover. Others, still, have it in every grade of increasing severity up to those malignant explosions that cause death in a few hours. It seems to me fair to conclude that these varying results are due to the interaction of two factors—differences in the quantity of the poison received, and differences in the power of resistance to the influence of the poison possessed by the several classes of persons mentioned.

(6) As to differences of susceptibility, there can be no question about that. Whites are far more susceptible than blacks. Men are more susceptible than women. Adults are more susceptible than children. Besides these broad distinctions, there are others not so manifest, but I think equally certain. Amongst the whites, those with dark hair and skin and

with what is sometimes called the bilious temperament are less susceptible than those with light hair and fair skin and the sanguine temperament; and the same individual is more susceptible at some times than at other times.

(7) For the purposes of the sanitarian, the length of the period of incubation is a consideration of importance, as upon this depends the rational period of detention of persons in quarantine. Our information in regard to this question is not so precise as we could wish it to be. It is commonly assumed that the solution of this question depends on the ascertained facts in cases where yellow fever occurs after a single exposure. In such cases as these, so far as I have been able to find out, the period of incubation is frequently only one or two days, and is rarely more than five days. Refugees who have yellow fever at all usually have it within five days after leaving the infected locality; but I am not at all sure that the same rule always obtains in the infected locality. Here doubtless the poison is passing into the system from day to day, and at the same time passing out of the system from day to day. If the elimination of the poison keeps pace with the introduction of it, the man does not have yellow fever at all; but if the process of elimination is defective, the poison accumulates until at last the resistance is overcome, and the febrile explosion follows.

(8) I cannot dwell on the question of diagnosis, although it is practically one of the utmost importance. If the case is severe, with yellow discoloration, suppression of urine, black vomit, and death, no physician of reasonable knowledge ought to have any difficulty in saying that it is yellow fever. But suppose the case is a mild one, without discoloration, without suppression, without black vomit, and without a fatal termination: how is the diagnosis to be made then? Even in such cases the expert finds but little difficulty. He recognizes his old acquaintance under all sorts of disguises. There is the three days of the initial fever, continued or *quasi* continued. There is the want of parallelism between the pulse and the temperature, which is usually observable to some extent even in mild cases; but the most certain diagnostic in this class of cases is the presence, to some extent, of albumin in the urine on the third or fourth day, usually on the third.

But all the problems so far suggested are preliminary to the great practical question of the prevention of the spread of yellow fever, which may be discussed under three different heads: (1) To prevent the introduction amongst us of yellow fever across the sea from foreign countries. (2) To prevent the transmission of yellow fever from one part of our own country to another by land. (3) To prevent the spread of yellow fever in our towns and cities after the outbreak of a few cases.

(1) The methods of maritime quarantine in this country may now be considered as definitely settled. They include the inspection of ships at the port of departure and at the port of arrival, with such detention and disinfection as may seem advisable. The larger number of our seaport quarantines are little more than inspection stations. These are supple-

mented by a sufficient number of thoroughly equipped refuge stations to which infected vessels are sent for treatment, said inspection stations being under the management of the marine hospital service. I take some special interest in these refuge stations because they grew out of a recommendation made by me to the National Board of Health in 1879. In the meantime a few of our large cities have well equipped disinfecting stations of their own, that at New Orleans being probably the most complete and the most efficient in its appointments. I think it may be fairly admitted that our maritime quarantine affords us a considerable degree of protection; and, fortunately, an immense majority of the vessels that come to us from infected ports are themselves free from infection. I should say that nineteen out of twenty of all vessels from infected ports are free from infection, and might be allowed *pratique* without any preliminary detention or disinfection. However this may be, and in spite of all possible quarantine diligence, yellow fever will sometimes find a lodgement in some of our seaport cities. There is contraband of revenue, and there must be contraband of quarantine. The appearance of yellow fever in one of our seaports is the signal and the warrant for the imposition of quarantine by land.

(2) The difficulties attending the administration of sea quarantine are many and great; but they are few and small indeed when compared with the difficulties attending the administration of quarantine by land. Land quarantine virtually resolves itself into the quarantine of the railroads; but the railroads are so numerous, they link together the towns and cities of the country in such an intricate network of connecting and intersecting lines of travel, and the travel over them is so rapid and continuous, flowing always, day and night, in never ceasing currents and counter-currents, that any adequate supervision of them becomes a matter of great perplexity and magnitude. The principle that underlies the practice of railroad quarantine amongst us is, that neither persons nor things shall be allowed to leave the infected place. To this end the railroad trains, both passenger trains and freight trains, are prohibited from stopping in or near the infected town, so that nothing can be taken on that is tainted with suspicion; and inspectors are kept on the trains so that nothing from the stricken community can be put off where it is not wanted—neither goods nor persons. This system of railroad quarantine is fundamentally correct, but in the administration of it the most outrageous excesses have been committed. The expenditures have been often so heavy as to be very burthensome to the corporations that have had to foot the bills; and commerce and travel have been interfered with to an extent not warranted by the imminence of the danger. The remedy for these evils is not far to seek. The several states concerned must place the administration of their quarantine laws in the hands of yellow fever experts, and must give to such yellow fever experts the power to overrule and supplement the work of non-expert municipal authorities. I have merely glanced at the subject of railroad quarantine, and must hasten on to the principal subject of my paper.

(3) What I want specially to consider is the management of yellow fever in our towns and cities after the occurrence of a single case, or of a few cases, so as to prevent its dissemination generally through the community; and in my judgment this sort of work depends on principles I now proceed to formulate. I confine myself to towns and cities, because in sparsely settled country neighborhoods yellow fever shows very little disposition to spread. It is urban and not rural.

(4) The extent and populousness of the town is an important consideration. The problem is difficult in proportion to the number of inhabitants, and in proportion as residences and business houses are crowded together. In a small, sparsely settled railroad town, where the houses are scattered about at considerable distances one from another, the problem is simple. In a densely populated city it is a problem of great complexity and difficulty.

(5) The golden rule of prophylaxis in yellow fever is isolation,—non-intercourse,—non-intercourse with infected places, non-intercourse with infected persons, and non-intercourse with infected things. Don't go near the fire and you won't get burned. Non-intercourse can be enforced in a very simple, very inexpensive, and very effective way. Let the people, with one accord, by common consent, in the exercise of the commonest sort of common-sense, keep away from the infected houses and localities, and refuse to have anything to do with infected persons or infected things. To do this so as to secure absolute safety, it would be necessary for the members of every family to shut themselves up in their own premises, and to enforce a strict domiciliary quarantine against all the rest of the world. But a reasonable degree of safety can be had without resorting to quite such extreme measures.

(6) At the beginning of an outbreak the infection is restricted within very narrow limits,—a single house, a block of houses, a single city square; and then it is necessary only to avoid the infected place or places, and to keep at a respectful distance the persons and things that have been exposed to the infection. Intercourse with other parts of the town is still perfectly safe. And, indeed, at this time a certain amount of intercourse with the infected region is also comparatively safe. You may go into the infected region many times and not take the fever. You may even nurse the sick for a long time without taking the fever. But while all this is true, no communication with the infected region should be allowed beyond what is strictly necessary. The pitcher that goes often to the well is apt to be broken in the course of time.

(7) In small places it would hardly ever be necessary to put guards around an infected house or an infected district. A simple warning to the people should be sufficient. In more populous communities guards may sometimes be desirable.

(8) But the sick must be taken care of,—must have nurses and doctors. What must be done with these? The doctor who spends but a little time with his patient is not likely to carry the infection with him

into other houses he may have occasion to enter. Still, by possibility he may become a carrier of the infection, and his intercourse with other people should be restrained according to circumstances. The nurse has no need to leave the premises of the patient, and should be kept under the strictest surveillance. When the area of infection begins to extend and cases to multiply, arrangements should be made for the isolation of nurses and of all other persons engaged in taking care of the sick. Take a house within the infected region, or near by, or as many houses as may be needed, for this purpose. I cannot dilate on this; only let it never be forgotten that the most active agents for the spread of yellow fever in any community are nurses and doctors and other attendants upon the sick, when they are allowed to eat and sleep in their own uninfected homes or boarding-houses; and in dealing with these attendants upon the sick, let it never be forgotten that amongst all the agencies that have been invoked to prevent the spread of yellow fever, non-intercourse is the first in importance—is so decidedly first in importance that all the others sink almost into insignificance.

(9) The practice of disinfection is mostly based on hypothetical grounds. But I think we have good reason to believe that it does good. The agents most to be trusted are heat, cold, the mercury bi-chloride, and sulphur fumigation. It is not proven that the yellow fever poison is connected in any way with the excretions of the yellow fever patient; but I think the alvine dejections and the urine should be disinfected and disposed of just as we would the excretions of typhoid fever.

(10) The probability that a few cases of yellow fever will spread into an epidemic depends very much on the latitude of the place and the season of the year. It is very generally believed by those who have studied yellow fever, that it requires for its prevalence and dissemination a long continued temperature of not less than seventy degrees Fah. It takes some time for yellow fever to gain a footing anywhere and under any circumstances. It cannot make any considerable headway in less than two weeks, and often it requires a much greater length of time. Yellow fever in July or August is much more to be dreaded than yellow fever in September or October; and quarantines may be still useful a hundred miles south of an infected town long after there ceases to be any excuse for it a hundred miles north of said town.

(11) When a few cases of yellow fever occur in a city, the general opinion is that depopulation is the surest way to prevent it from expanding into epidemic dimensions. Take away the fuel, and the fire will soon cease to burn. This plan is plausible at first sight, and I do not question its efficacy. But it is attended with so many incidental disadvantages that it seems to me to be the most objectionable plan for general adoption that has ever been devised. It is not very difficult, indeed, to depopulate the infected district so long as it is restricted within narrow limits; and I believe that depopulation of an infected district may often be the highest dictate of sanitary wisdom. It would be quite possible, also, to depopulate a small town of only a few hundred inhabitants, or perhaps

even a city of a few thousand inhabitants. But it would be folly to attempt to depopulate a great city like New York or New Orleans. But there is never any urgent need for the depopulation of small and sparsely settled villages. In them yellow fever can be managed easily by other methods. And just precisely in proportion as the population increases in numbers and density, just in that same proportion increase the danger of the epidemic and the consequent desirability of depopulation, if that is to be accepted as the proper plan of management. In other words, the more we need the remedy, the greater becomes the difficulty of using it.

(12) With us depopulation, so far as it is accomplished at all, is accomplished only in one way, namely, by the wild and reckless stampede of a demoralized and panic-stricken people. Almost all who are able to go do so, and a great many who are not able. The impecunious are left behind to the mercy of the pestilence and the charity of the compassionate. In the meantime the depopulation is never complete. From one third to one half of the people are obliged to stay at home, because they are not able to pay the expenses involved in getting away and living somewhere else. And this is not the worst. These flying people spread panic wherever they go, the panic being far more infectious than the fever; and then follows an epidemic of quarantines. The big towns quarantine because they have so much at stake; and the little towns quarantine because they think they have as much right to be protected as their big neighbors. And such quarantines!—unlawful, extravagant, absurd, grotesque, foolish, cruel,—in one word, abominable beyond all that words have power to give expression to. If the history of them could be written, it would fill up a goodly portion of that history of human folly which Prof. Porson proposed to write in five hundred volumes.

(13) Another agency in the management of epidemics needs to be mentioned here—the agency of refugee camps. *A priori* one would think they would serve a good purpose, but practically they have always been failures, and they must continue to be failures. In the first place, it is next to impossible to get a place for the establishment of a refugee camp. People do n't want refugee camps anywhere in the neighborhood of their residences, and won't have them. In the second place, when you succeed in establishing a camp, it accomplishes comparatively little because you cannot drive the people of the infected town into it; and I do n't blame them for their reluctance. If you had the power of a Russian czar, by force of arms you might drive the people into the camp, but in no other way.

(14) I have thus endeavored, in a very brief and imperfect fashion, to indicate what we know of the natural history of yellow fever, and of the conditions which mark its propagation in time and space. I have, also, in the same brief and imperfect fashion, indicated some of the evil consequences of our present methods of managing yellow fever epidemics. I need not go further back than the history of this present year to point the moral I have in mind. We have seen the people of the entire South

wild with panic, flying recklessly from their homes, and scattering consternation and dismay all over the country. I suppose there is no other single consideration that stands so much in the way of Southern development as this spectre of yellow fever which is always associated with our sunny climate in the minds of the people who desire to settle amongst us. How is all this to be changed? There is but one way. We must educate our people, our doctors, and even our health officials, to a better appreciation of the true character of the enemy we have to battle with. Let it be understood that yellow fever is not contagious from person to person as small-pox is; that in a majority of instances, when introduced into our communities, it fails to spread at all; that when it does spread, it spreads at first very slowly, so that the threatened people always have plenty of time to await the progress of events; that if it becomes desirable for the people to leave their homes, there will always be opportunities for them to do so in a systematic and orderly way. In a word, we must manage our yellow fever epidemics in a common-sense, business way. We must get rid of our panics, our stampedes, and our shot-gun quarantines. The guardians of the public health owe it to themselves and to the people they serve to effect such a change in public opinion as will make it possible in the future to avoid the follies which have convulsed and disgraced the country in connection with our yellow fever epidemics during the last fifteen or twenty years.